REMARKS

Status of Application

Claims 1–36 remain pending in the present application. A typographical error on page 16 of the specification has been corrected, and Claims 1, 16, and 25 have been amended to more clearly distinguish over the cited art.

Claims Rejected under 35 U.S.C. § 102(a)

Claims 1-36 have been rejected as anticipated by Chen et al., "View Interpolation for Image Synthesis," ACM, 1993, pages 279-288 (hereinafter referred to as "Chen"). In regard to independent Claim 1, the Examiner asserts that Chen discloses each of the steps of the claim and refers to a disclosure by Chen of using morph maps to compute shadows from area lights, with reference to page 282, col. 1, section 4 of the cited reference. However, for the reasons set forth below, applicant asserts that Claim 1 and the other independent Claims as amended clearly distinguish over Chen.

There are several important differences between the teaching of the Chen reference and the invention as defined in applicant's amended claims. An object of the technique taught by Chen is to enable a large number of images of an environment to be generated from multiple spaced viewpoints. On page 279, col. 1, section 1 of Chen, the reference teaches that an exemplary application of the technique disclosed in the article is to provide a changing view of an external environment from the cabin of an aircraft simulator using a relatively low end computer without substantial Z-buffer hardware capability. It is clear throughout Chen that the technique discussed therein deals with a static scene that is viewed from a plurality of different viewpoints. In contrast, the present invention is directed to portraying objects in a scene that may dynamically vary, but which are always viewed from a single static viewpoint. Accordingly, for this reason alone, it should be evident that Chen is not applicable to the invention as now recited by applicant's independent Claims 1, 16, and 24.

On page 281, section 2.2 of Chen, the reference teaches how to generate in-between views of a pair of images, each having a different viewpoint. In contrast, each of the examples of the present invention provided by applicant relates to a single static viewpoint for which a plurality of morph maps are produced for an object. The Chen technique is capable of performing different view interpolation tasks involved in the navigation of a static scene between

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different viewpoints, including motion blur and shadows, but is unable to handle complex global effects like refractions. Also of considerable importance is the inability of Chen to handle anti-aliasing in realtime, as is evidenced by the third paragraph of section 3.3, col. 1, page 283 of Chen which states that "...for the interpolation to work properly, the source image cannot be anti-aliased. Anti-aliasing is view-dependent." Chen suggests a workaround for dealing with anti-aliasing in images, however, the Chen technique does not include storing anti-aliasing data for each morph map. Also, the temporal anti-aliasing discussed in section 4 of Chen is not equivalent to the anti-aliasing recited in applicant's claims, as discussed in greater detail below.

On page 281, section 2.1 of Chen teaches that the transformations that are carried out between images at different viewpoints are done in three dimensions, using a 4x4 matrix, in regard to the x, y, and z pixel screen coordinates for each pixel. Chen teaches that "the transformations can be pre-computed and reduced to a 3D spatial offset vector for each of the pixels." In contrast, the present invention carries out transformations two dimensionally, which is preferable to reduce the computing time required for the transformations. Chen discusses the use of forward mapping, but explains that his technique can cause holes and overlaps as the technique interpolates between different viewpoints relative to a scene. In contrast, the present invention maintains a single static viewpoint and is not subject to such problems.

In consideration of the differences noted above, applicant has amended Claim 1 (and the other independent claims) to more clearly distinguish over Chen. Specifically, Claim 1 recites "a method for simulating a real-time rendering of a desired graphical effect in an image of an object on a display, in regard to a single static viewpoint." Similarly, subparagraph (a) of Claim 1 recites "precomputing data defining a behavior of light rays illuminating the object in regard to the singles static viewpoint, based on a plurality of input images, to produce a plurality of morph maps for the object in which at least one set of pixel-dependent data is associated with each pixel position on the display." Applicant also notes that Chen does not disclose producing a plurality of morph maps for an object, but instead produces a plurality of morph maps of a complete static scene or full image, in regard to different spaced apart viewpoints of the scene. Accordingly, it should be apparent that applicant's claimed approach does not require that the behavior of light rays illuminating the ***entire*** background and other portions of the image be precomputed, but instead, produce a plurality of morph maps only for the object in question.

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In addition, subparagraph (b) of Claim 1 now recites "performing a transformation two-dimensionally using the plurality of morph maps" in response to either a user action or an event that indicates a desired graphical effect, to produce an output image that simulates the real-time rendering of the desired graphical effect. As noted above, Chen uses a three-dimensional transformation and is therefore more computationally intensive than the invention claimed by applicant.

In regard to the rejection of dependent Claim 3, the Examiner suggests that page 283, section 3.2 of Chen discloses "the step of producing data that include an additive factor that is used to control saturation of the output image." However, in reviewing section 3.2 of Chen, it is apparent that Chen only refers to interpolation parameters and never mentions or suggests "an additive factor" for use in controlling saturation of an output image. Thus, there is no basis for the Examiner's suggestion that Chen anticipates Claim 3.

In Claim 6, applicant recites that the "step of performing the transformation comprises the step of mapping a selected portion of a surface of the object onto a different part of the object to simulate an effect corresponding to movement of the selected portion of the surface over the object." The Examiner suggests that this aspect of applicant's invention is taught on page 281, in section 2.1 of Chen. However, having reviewed that section it is apparent that there is no discussion therein of mapping a portion ***of a surface of an object onto a different part of the object.*** Instead, this section of Chen discusses establishing a pixel correspondence to implement arbitrary forward mapping functions for image warping. There is simply no disclosure in Chen that would lead one of ordinary skill in the art to understand how to implement what is recited by applicant in Claim 6.

Similarly, Claim 7, which depends on Claim 6, recites that "only pixels of the object that have been altered during the transformation to implement the effect are recomputed in the output image." Section 2.1 of Chen fails to mention or suggest that only pixels of an object altered during a transformation are recomputed. It is not surprising that Chen fails to refer to this aspect of applicant's invention, since Chen does not deal with implementing an effect on a particular object within a scene.

The Examiner rejects Claim 8 on the basis that on page 280, col. 2, section 3, paragraph 3, Chen teaches employing a quad tree block and grouping the pixels and moving the pixel blocks. However, it appears that the quad tree is used for compression of data, and that Chen does not disclose "determining a union of all rectangles that are associated with the cells of

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the grid that intersect the area of the arbitrary rectangle, to produce the output image." Selecting scattered words in Chen that appear to have some relationship to the recited elements in applicant's claims, without considering the context in which those terms are used in the cited art is not an acceptable basis for rejecting applicant's claims. Accordingly, Claim 8 is not taught or suggested by Chen.

Claim 11 provides that "the step of precomputing includes the step of storing anti-aliasing data for use in producing the output image." As noted above, section 3.3 on page 283 discusses a workaround for a source image that is anti-aliased, but indicates that the source image cannot be anti-aliased using interpolation, because anti-aliasing is view-dependent. Accordingly, it is clear that Chen does not teach or suggest storing anti-aliasing data for use in producing the output image. Instead, Chen provides a technique that avoids the problems of an anti-aliased image, without using the information regarding anti-aliasing. Therefore, Claim 11 is not anticipated or obvious in view of Chen.

In the rejection of independent Claim 16, the Examiner again indicates that Chen discloses all of the steps of the method, however, for the reasons already noted, it is apparent that Chen does not provide for "precomputing a plurality of morph maps of a displayed scene in regard to a single static viewpoint, said plurality of morph maps being blendable and including anti-aliasing information and data for each of the variety of pixels in a defined area." Subparagraph (a) of Claim 16 thereby distinguishes over the disclosure of Chen. Similarly, subparagraph (c) recites "transforming at least one input image two-dimensionally using a blending to the plurality of morph maps to produce the selected effect in an output image." Thus, for the reasons already noted in regard to Claim 1 and in other portions of the preceding comments, Claim 16 clearly distinguishes over the disclosure of Chen.

In rejecting Claim 17, the Examiner cites to page 283, Col. 1, section 4 of Chen. The Examiner suggests that this portion of Chen discloses "anti-aliasing to smooth edges in the output image." However, section 4 of Chen refers to "temporal anti-aliasing, or motion blur," and suggests that such motion blur can be accelerated by using morph maps. One of ordinary skill in the art will clearly understand that temporal anti-aliasing to create motion blur is entirely different than anti-aliasing to smooth edges in an output image. Applicant explains the means of anti-aliasing on page 7, starting at line 30. Accordingly, it is apparent that the disclosure by

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Chen of temporal anti-aliasing to create motion blur is not in any way equivalent to anti-aliasing to smooth edges in an output image, as recited by applicant's Claim 17.

Claim 20 recites "wherein the effect comprises the rendering of a textured patch on a surface of an object as the patch is dragged over the surface by a user, further comprising the step of indexing pixels on the input image to corresponding pixels in the output image in which the patch is illustrated as it is dragged." In rejecting Claim 20, the Examiner cites to page 280, col. 1, paragraph 1 of Chen. However, that portion of Chen simply refers to interpolating corresponding pixels between two successive images under a user's control to create in-between images. There is clearly no teaching or suggestion of all the details recited in Claim 20 in Chen. Applicant is hard pressed to understand the Examiner's basis for rejecting Claim 20 over the unrelated teaching of interactively interpolating pixels by Chen.

Claim 22 recites that "only pixels in the input image that have changed are transformed to produce the output image." The Examiner suggests that page 281, section 2.1 of Chen teaches this aspect of applicant's claimed invention. However, there is no teaching or suggestion that the Chen interpolation between morphed images is only applied in regard to pixels in an input image that have changed, in order to produce an output image. Thus, there is no basis for rejecting Claim 22 in view of the disclosure of Chen.

The Examiner has rejected independent system Claim 24 and corresponding dependent Claims 25-36 on the same rationale used in rejecting independent Claim 1 and dependent Claims 2-15, respectively. Applicant therefore traverses this rejection on the basis that independent Claim 24 is patentable for the same reasons discussed above in regard to independent Claim 1. In addition, each of the dependent Claims corresponding to those discussed above are patentable for the same reasons already set forth.

In addition, applicant notes that each dependent Claim is patentable for at least the same reasons as the independent Claim from which it ultimately depends. Accordingly, each of the dependent Claims that have not been specifically discussed above are patentable for the reasons set forth in regard to the independent Claims in this case.

In consideration of the preceding remarks and the amendments to the Claims, it should be apparent that all Claims in the application define novel and nonobvious subject matter. Accordingly, applicant requests that the Examiner pass this case to issue without further delay.

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In the event that any further questions remain, the Examiner is invited to telephone applicant's attorney at the number listed below.

Respectfully submitted,

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I hereby certify that this correspondence is being deposited with the U.S. Postal Service in a sealed envelope as first class mail with postage thereon fully prepaid addressed to: Commissioner of Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on June 25, 2003.

Date: June 25, 2003

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